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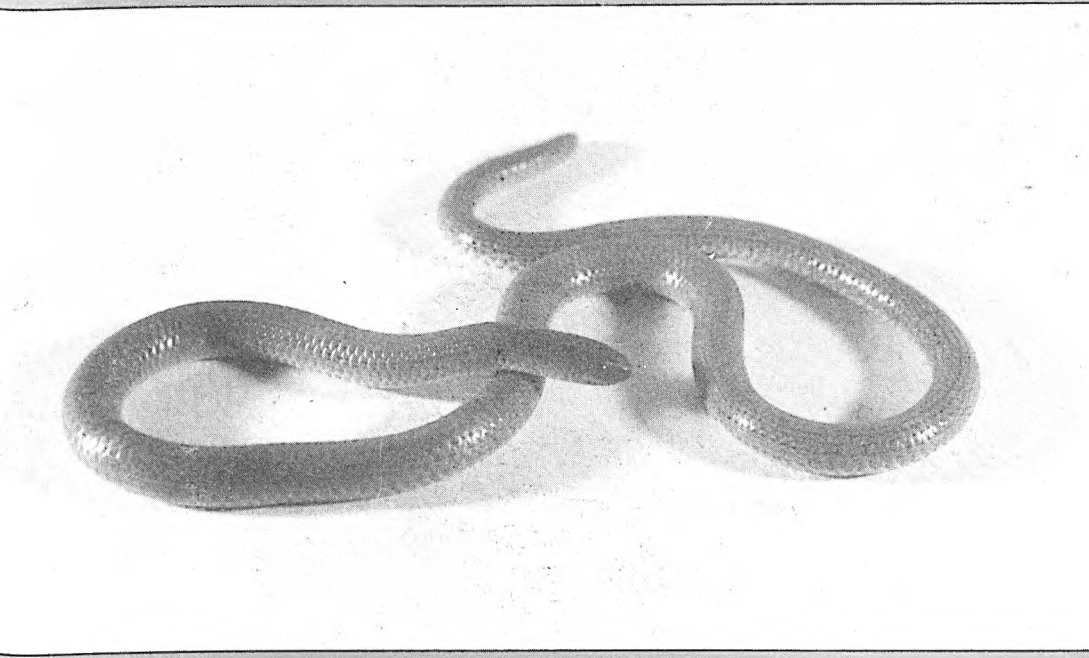

**APRASIA PARAPULCHELLA**

This lizard has a patchy distribution in and near the ACT. During a recent field trip the ACT Herpetological Association found two specimens at a new location in NSW near Queanbeyan. This species appears to be particularly associated with areas where the ground cover is predominantly native grasses.

*photo Geoff Swan*

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# NOTES ON THE BIOLOGY AND CONSERVATION OF *PHILORIA SPHAGNICOLUS* (MOORE 1958) (ANURA: *MYOBATRACHIDAE*)

G.A.Webb, *
Forestry Commission of New South Wales, P.O. Box 100, Beecroft, NSW, 2119.

* Present address: Rhone-Poulenc Rural Aust. Pty Ltd., Private Bag 19 Homebush NSW 2140

## ABSTRACT

New data on the distribution, habitat and diet of *Philoria sphagnicolus* are presented. The conservation status of *P. sphagnicolus*, and other cryptic frogs is discussed.

## INTRODUCTION

*Philoria sphagnicolus* (Moore 1958) is a member of a small genus of eastern Australian myobatrachid frogs. All species are apparently restricted to isolated montane and alpine areas (Barker and Grigg 1977, Cogger 1986, Moore 1961). *P. sphagnicolus* is known from a number of scattered locations in northern New South Wales (Anstis 1981, Cogger 1986, Wotherspoon 1981) where it appears to be restricted to rainforest and rainforest margins (Cogger 1986).

Although the embryological, larval and breeding biology of *P. sphagnicolus* had been studied (Anstis 1981, Moore 1961, Watson and Martin 1973) very little is known of its distribution and habitat and other aspects of its life history.

During October-November 1980 a fauna survey was carried out in the rainforests and adjacent tall eucalypt forests of the upper Hastings River catchment near Wauchope New South Wales. Various methods including pitfall trapping were used to record the small ground-dwelling vertebrate fauna. Of particular interest was the presence of *P. sphagnicolus* in six of the eleven sites at which pitfall trapping was carried out. These specimens and associated data provided the opportunity to describe the habitat and diet of *P. sphagnicolus* and to discuss the distribution and conservation status of this species.

## STUDY AREAS AND METHODS

Details of study sites are given in Table 1. Five pitfall traps were installed in each site. Pitfall traps consisted of 5l plastic buckets containing a 10% solution of formalin. Drain holes were cut in the sides 10 cm from the bottom to drain off excess fluid during rain. Traps were sunk into the ground, flush with the substrate and spaced 15 m apart and, where possible, along the contour. All pitfall traps were installed during the period 28-29 September 1980, except for site 3, where they were installed on 20 October 1980. All traps were emptied and removed on 1 November 1980.

All specimens of *P. sphagnicolus* were returned to the laboratory and dissected to examine the stomach contents.

## RESULTS AND DISCUSSION

### HABITAT

Almost all records of *P. sphagnicolus* are from rain forests and wet sclerophyll forests (Anstis 1981, Wotherspoon 1981, this study). In Mt Boss S.F. *P. sphagnicolus* was found at sites in cool temperate and warm temperate-subtropical rainforests and in wet sclerophyll forests with a rainforest understorey (Table 1.) Anstis (1981) also records partially cleared montane eucalypt forest as habitat for this species.

Three of the six sites at which *P. sphagnicolus* were found at Mt Boss had suffered some degree of disturbance by logging; one heavily logged in the early 1980s, one selectively logged during the same period and the other selectively logged during 1978. The degree of disturbance observed in these three sites in October 1980 was minimal as the older disturbed sites had regenerated substantially since the logging operations and the more recently disturbed site was only marginally affected.

Anstis (1981) recorded all of her specimens from near flowing creeks however none of the Mt Boss S.F. specimens was closely associated with creeks. Proximity to flowing water may only be necessary during the breeding season and particularly at the time of oviposition.

In the catchment of the upper Hastings River there was no apparent relationship between the occurrence of *P. sphagnicolus* and habitat attributes such as slope, litter depth and sunlight penetration (Table 1).

### DIET

A wide range of invertebrate prey items were recorded from the stomachs of the eight *P. sphagnicolus* specimens (Table 2). Ants were the dominant (42.2% or prey items) food source. The range of prey items and the dominance of ants is not inconsistent with other small ground-dwelling myobatrachid frogs (Pengilley 1971, Webb 1983).

### DISTRIBUTION

*P. sphagnicolus* is currently known from five broad localities along the eastern escarpment of the Great Dividing Range in New South Wales (Table 3). At the northern extent of its range *P. sphagnicolus* has been found on the New England Plateau (New England National Park and Styx River State Forest) and the Dorrigo Plateau (Dorrigo National Park). Further south, this species is present in the headwaters of the Wilson and Forbes rivers (Mt Boss State Forest and Werrikimbee National Park) and the Comboyne Plateau (Elands and Boorganna Nature Reserves). The southern-most population occurs on the Williams River near Barrington Tops National Park.

*P. sphagnicolus* was originally thought to be restricted to montane regions above 1300 m however it has now been found at a wide range of elevations from ca.350 to 1341 m (Anstis 1981, Wotherspoon 1981, This study). The southern-most populations were found at the lowest elevations (Table 3). The range of elevations at which *P. sphagnicolus* was recorded during this study was 720-1120 m above sea level but there was no apparent relationship between occurrence and elevation in the study area (Table 1).

Brattstrom (1970) considered that *P. sphagnicolus* had limited thermal tolerance however the range of elevations recorded so far suggest a much wider tolerance than previously thought.

## CONSERVATION STATUS

*P. sphagnicolus*, like *Philoria loveridgei*, is currently a protected species in New South Wales (Jenkins 1985, Ehmann and Cogger 1985) by virtue of limited distribution and habitat sensitivity. Several factors suggest that *P. sphagnicolus* is not as rare and endangered as originally thought: it is now known from a wide range of localities in the eastern highlands (albeit a disjunct distribution); it is known from various natural and man-modified habitats and it may be locally common (Wotherspoon 1981). Further, its presence primarily in areas of nature conservation tenure suggest that the preferred habitats of *P. sphagnicolus* may be adequately protected.

By way of comparison, its congener *Philoria frosti* is considered rare and endangered (Jenkins 1985, Ehmann and Cogger 1985, Rawlinson 1981) as it occurs only on an isolated mountain-top (Mt. Baw Baw) in Victoria.

Wotherspoon (1981) provided some insight into the problems of conserving *P. sphagnicolus* and other apparently rare frogs. He observed a large number of *P. sphagnicolus* on one night (after 2 days of rain) but two nights later they had all but disappeared. If Wotherspoon (1981) had not made the original observation he could have decided that *P. sphagnicolus* was rare in the area. Given that most frogs are dependent on free water for breeding it is likely that most species will be most detectable during and after heavy rain or when water is freely available. Surveys at these times are likely to significantly alter our interpretation of the distribution and conservation status of some species. This has been clearly demonstrated recently for *Heleioporus australiacus* (Webb 1987) in southeastern New South Wales. Similarly, Roberts (1985) suggested that *Arenophryne rotunda*, a small myobatrachid frog of Western Australia, is unjustifiably considered rare attributing much of this apparent rarity to the frogs fossorial nature and the inhospitable nature of its habitat during much of the year.

With greater knowledge of the biologies of apparently rare frogs, many species currently protected by legislation should no longer require formalised species protection. I consider that *P. sphagnicolus* fits into this category. The need for a more rational approach to the conservation of Australian reptiles and frogs has been strongly argued recently (Ehmann and Cogger 1985, Jenkins 1985, Roberts 1985).

## ACKNOWLEDGEMENTS

The Forestry Commission of NSW and New South Wales National Parks and Wildlife Service kindly allowed permission to work in the Hastings River catchment. Ross Sadlier (Australian Museum) and Liz Dovey (NSW NPWS) kindly allowed access to records from their respective institutions. Harry Ehmann and John de Bavay provided helpful comments on the manuscript.

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**TABLE 1:**

Habitat data on sites in Mt Boss State Forest where *P. sphagnicolus were found*

| | SITES | | | | | |
|---|---|---|---|---|---|---|
| | 1 | 2 | 3 | 4 | 5 | 6 |
| Forest type | warm temperate/ sub-tropical rainforest | wet Sclerophyll/ rainforest understorey | wet Sclerophyll/ rainforest understorey | cool temperate rainforest | cool temperate rainforest | cool temperate rainforest |
| Logging history | unlogged | unlogged | heavily logged 1962-3 | unlogged | selective logging 1978 | selective logging 1961-63 |
| Elevation (m) | 900 | 1000 | 720 | 1060 | 1120 | 1080 |
| Slope (°) | 40 | 30 | 16 | 1-2 | 1-2 | 11 |
| Aspect (°) | 240 | 290 | 230 | 315 | 330 | 120 |
| Average litter depth (cm) | 2 | 6 | 8 | 7 | 5 | 4 |
| Sunlight penetration (%) | 10 | 15 | 20 | 10 | 5 | 25 |
| Nº of specimens | 2 | 1 | 1 | 1 | 1 | 2 |

**TABLE 2:**
Stomach contents of eight specimens *P. sphagnicolus* caught in pitfall traps in Mt. Boss State Forest.

| | Proportion total No. of food items (N=32) % | Proportion of total No. of stomachs (N=8) containing each food group % |
|---|---|---|
| Arachnids | | |
| mites | 6.3 | 12.5 |
| pseudoscorpions | 3.1 | 12.5 |
| harvestmen | 9.4 | 37.5 |
| Crustaceans | | |
| slaters | 9.4 | 25.0 |
| Insects | | |
| collembola | 3.1 | 12.5 |
| beetles (adults) | 12.5 | 12.5 |
| beetles (larvae) | 3.1 | 12.5 |
| ants | 37.5 | 62.5 |
| wasps | 12.5 | 25.0 |
| Millipedes | 3.1 | 12.5 |
| Parasitic Nematodes | many | 100.0 |

**TABLE 3:** Broad localities and other data on *P. sphagnicolus* records.

| LOCALITY | GRID REF. | DATE | COLLECTOR | REFERENCE |
|---|---|---|---|---|
| **NEW ENGLAND PLATEAU** | | | | |
| 2km W. Barwick R. near Point Lookout | 30°29'S 152°24'E | 24/28.12.1974 | M. Anstis | Anstis (1981) |
| Styx River S.F. near Point Lookout | 30°29'S 152°24'E | 30.12.1974 | M. Anstis | Anstis (1981) |
| New England Plateau Point Lookout Road | | 01.1975 | H. Ehmann & M. Anstis | AM collection |
| Point Lookout near Ebor | | 21.11.1952 | J.A. Moore | AM collection |
| Point Lookout near Ebor | | 12.1959-04.1961 | H.G. Cogger | AM collection |
| Point Lookout | | 12.1958-12.1971 | J. de Bavay | AM collection |
| New England N.P. near Point Lookout | 30°29'S 152°24'E | 16.11.1980 | J. Morris | NPWS inventory |

| LOCALITY | GRID REF. | DATE | COLLECTOR | REFERENCE |
|---|---|---|---|---|
| **Dorrigo Plateau** | | | | |
| Dorrigo N.P. | | 02.12.1971 | Frazier et al. | AM collection |
| Dorrigo N.P. Crystal Shower Falls | | 16.05.1963 | H.G. Cogger | AM collection |
| Dorrigo N.P. | 30°22'S 152°44'E | 10.12.1963 | A.B. Rose | NPWS inventory |
| **Hastings River Catchment** | | | | |
| Mt. Boss S.F. Mount Boss | 31°12'S 152°23'E | 08.09.1978 | M. Dodkin | NPWS inventory |
| Mt. Boss S.F. Forbes River | 31°20'S 152°20'E | | I. Pulsford | AM collection |
| Mt. Boss S.F. | 31°15'S 152°20'E | | A.B. Rose | AM collection |
| Mt. Boss S.F. Waterfall Forest Reserve | 31°12'05"S 152°19'40"E | 10.1980 | G.A. Webb | This study |
| Mt. Boss S.F. South Plateau Road | 31°12'15"S 152°20'00"E | 10.1980 | G.A. Webb | This study |
| Mt. Boss S.F. Valley Road | 31°12'05"S 152°22'05"E | 10.1980 | G.A. Webb | This study |
| Mt. Boss S.F. Banda Flora Reserve | 31°09'50"S 152°24'15"E | 10.1980 | G.A. Webb | This study |
| Mt. Boss S.F. Cockerawombeeba Rd | 31°09'30"S 15222'00"E | 10.1980 | G.A. Webb | This study |
| Mt. Boss S.F. Thumb Road | 31°09'05"S 152°21'25"E | 10.1980 | G.A. Webb | This study |
| **Comboyne Plateau** | | | | |
| Elands, 2km S. | 31°39'S 152°18'E | | M. & R. Anstis | AM collection Anstis (1981) |
| Boorgana N.R. | 31°36'S 152°28"E | | A.B.Rose | AM Collection Anstis (1981) NPWS inventory |
| **Barrington Tops** | | | | |
| Barrington Tops N.P. | 32°10'S | | D. Wotherspoon | Wotherspoon (1981) |
| Williams River | 152°32'E | | | |

## SURVIVAL FROM DEATH ADDER BITE OR HOW THE MIGHTY FALL.

Roy D. Mackay, CMB 16 Paluma, Qld. 4816.

This account of a bite from a Death Adder *Acanthophis antarcticus* was noted as incidental to an attempt to get back to civilization from the wilds of the Papua New Guinea rainforest. I can laugh now.

I have a project to study one of the most beautiful birds in the world, the Fire-maned Bowerbird *Sericulus bakeri*, found only in the hill forests of the isolated Adelbert Range on the northern side of Papua New Guinea (PNG). Last November (1988) I was accompanied by Dr James Menzies, Biologist, University of Papua New Guinea. Incidentally, James collected about 23 species of frogs in a 100 metre stretch of rainforest by our camp at 1000 metres altitude, including possibly three new species.

There is only one airstrip, Wanuma, 690m altitude, in the whole of the Adelbert Range – no roads. We had already had trouble getting a plane into the area and lost four days of our intended two week trip waiting for weather reports to be favourable. At the end of six days in the study area we walked back to the airstrip to catch the plane we had booked to take us back to Madang.

Eight days of rain later and no plane, so we decided to walk out – two days – to a roadhead near Utu Mission where we could be met by a vehicle for the one hour drive to Madang.

At 1100 hours on the first day of the walkout, we came to the bank of the Numugen River. We were told previously that we had to cross four large rivers. What we were not told was that we had to cross each of these rivers six times.

Almost on the water's edge, among some grasses "green and rank" (Paterson 1946) I saw a snake crawling along. By the patches of the snake I could see amongst the grass I saw it had keeled scales, it was a dull olive-green colour with thin zig-zag black bands across the body. It was slim and about 50cms long. Well, what else would it be but a harmless *Natrix/Amphiesma/ Styporhynchus/ Tropidonophis sp.* I ask you?

Peering through my bifocals, I bent down to catch it and was very promptly bitten on the big knuckle of the third finger (fourth digit), right hand. I flipped the snake off as a natural reflex and it made good its escape. I looked at the bite and saw blood and water? or venom? Anyway I sucked away the surface material and spat it out. I examined the bite and saw a familiar pattern of two fang marks followed by a couple of other tooth marks and a few palatine tooth marks – as figured in most snake books. Of course I now had doubts about my identification of the snake and had to think seriously that I had been bitten by a dangerous snake. Only two deadly terrestrial snakes occur in that area (middle Sogeram Valley), the Death Adder *Acanthophis antarcticus* and the Small-eyed Snake *Micropechis ikaheka* and it was definitely not the latter that bit me (Slater 1968).

During the next six hours while we trekked to the village where we were to spend the night, my finger became stiff and swollen; but this can happen from the bite of a harmless snake as a reaction to the protein in the snake's saliva (Bellairs 1969, Campbell 1966). At the same time a line of pain had moved up my arm to the lymph glands at the elbow joint and in the arm-pit. The glands, though tender did not swell and the pain was only noticeable to the touch. I did not use a tourniquet nor did I wrap a bandage along my arm. The six hour walk was quite strenuous but I had no more symptoms until we reached the village of Imam and settled in for the night. I then became drowsy, my eyelids became heavy and it was difficult to open them. My eyesight became fuzzy and unco-ordinated. My legs became weak and wobbly and I found difficulty in maintaining my balance. These symptoms I knew, were the early symptoms of neurotoxic envenomation (CSL 1948). These symptoms intensified during the night. I was taken very good care of by James and, early the next morning (25th), he arranged with the local villagers to make a litter and for three changes of carriers for the ten hour walk out to the roadhead. The only other symptom was an occasional headache which was suppressed with asprin, though

this symptom could be related to a bit of dysentry we both had from drinking unboiled river water the day before – an unhealthy thing to do in lowland Papua New Guinea.

Some parts of that day I cannot remember. I do recall the slap slap of the carriers' feet on the muddy forest floor, the sudden downpours of rain, the occasional period of dappled sunlight. I must have slept for some of the time. By the time we reached the roadhead where we were met by a nurse from the Utu Mission Hospital, I was feeling slightly better. The nurse gave me a penicillin injection and a Tetox injection against tetanus. In the following days I took a course of penicillin (Amoxillin) tablets. The nurse also checked my pulse, breathing and blood pressure – all normal. From then on I was on the road to recovery.

At about 9.00am the next morning (26th), I rang Dr. Bart Currie of the Port Moresby General Hospital, a friend of mine and an authority on the treatment of snake bite. He showed keen interest in my case especially as I had not had antivenine treatment. He confirmed that the symptoms I had were consistent with Death Adder bite. He also comforted me by saying that, if I did not get any worse symptoms in the next three hours, I would be out of danger as the neurotoxicity of Death Adder venom progresses to maximum symptoms by 24-48 hours. It was an uncomfortable three hours to wait. Bart is still a friend.

My legs lost their wobbliness in three days, my eyes could focus better within five days and the eyelids lost their droopiness in eight days. The pain along my arm subsided over five days but the stiffness and sensitivity in my finger did not disappear for sixteen days. These times were counted from the day I started to improve, the 26th. Well, I am here to tell of it. I have always prided myself on being the only snake collector I know personally who has not been bitten by a dangerous snake. No more. And the lesson I learnt is not to catch snakes if you have to wear bifocals or other spectacles.

## ACKNOWLEDGEMENTS

I especially thank Dr. James Menzies for his calm manner and his care in getting me to medical treatment in the quickest way possible. I am very grateful to the people of Imam and Pimaga villages who had the arduous task of carrying me for ten hours. I am grateful also to Dr. Bart Currie for his interest and assistance in my case. I acknowledge with thanks the help of Dr. B. Currie, Dr. J. Menzies and Dr. H. Cogger in reading the draft of this article.

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# THE REPTILES OF MUNGO NATIONAL PARK AND THE WILLANDRA LAKES REGION

R.A. Sadlier
Herpetology Department
Australian Museum
P.O. Box A285
SYDNEY SOUTH NSW 2000

G.M. Shea
Dept. of Veterinary Anatomy
University of Sydney
NSW 2006

## ABSTRACT

The herpetofauna of the Mungo National Park and the Willandra Lakes region was surveyed in spring-summer of 1984-85. From this survey and other sources a total of 39 reptile species are recorded for the region. *Unechis nigriceps* is recorded from N.S.W. for the first time. The amphibian fauna of the region has yet to be established; no species were recorded during the course of the survey. The dry lakes and fringing lunettes are topographic features peculiar to the area. Four species of scincid lizard *(Ctenotus uber, Ctenotus strauchii varius, Morethia adelaidensis, Eremiascincus richardsoni)* were largely restricted to habitats associated with the dry lakes. Other reptile species were distributed over mallee woodland, and mixed woodland and shrubland habitats not associated with mallee. Eight species of lizard *(Ctenophorus fordi, Amphibolurus nobbi, Diplodactylus elderi, Lucasium damaeum, Delma butleri, Ctenotus atlas, Ctenotus brachyonyx, Egernia inornata)* were found to occur only in mallee woodland with *Triodia* understory and/or patches of large *Triodia* tussocks in isolation.

## INTRODUCTION

### Background

As part of the faunal studies undertaken by the N.S.W. Department of Planning and Environment in the Willandra Lakes World Heritage Region, the Herpetology Department of the Australian Museum was contracted to survey the reptile and amphibian fauna.

A preliminary computer search of the departments extensive specimen reference collection (100,000 + individual records) showed the whole of the southwest region of N.S.W. to be poorly represented with virtually no records for the Willandra Lakes region.

Regional herpetofaunal surveys of habitats comparable to those occurring within the Willandra Lakes region are few in eastern Australia. The majority of studies are from the northwestern region of Victoria. For western N.S.W. Cogger (1984) documents the distribution by habitat of 36 reptile species occurring in largely mallee habitat at Round Hill Nature Reserve. Caughley (1985) lists 22 species from similar habitat in the same region when discussing the effect of fire regimes on this habitat. Henle (1987) provides an annotated species list of the herpetofauna occurring in mallee and grassland habitats of Yathong Nature Reserve (approximately 70km N.W. of Round Hill Nature Reserve). Both areas are some 300 km to the northeast of the Willandra Lakes study area. In eastern S.A. Baverstock (1979) and Morley and Morley (1985) surveyed the herpetofauna of two areas containing mallee associated habitat.

In northwest Victoria, small to moderately large reptiles and amphibians are reasonably well documented from the small vertebrate surveys of Beste (1970), Cockburn *et al.* (1979), Mather (1979) and Menkhorst (1982). Rawlinson (1966) had earlier listed the reptiles of the Victorian mallee, although the nomenclature used is now very much outdated and a number of the early records cited have not been substantiated by more recent collections (A.J. Coventry pers. comm.). Simpson (1973) listed the reptile species associated with the Murray River between Mildura and Renmark.

The survey work of the Willandra Lakes region undertaken by the Herpetology Department of the Australian Museum and on which this report is primarily based consisted of an initial spring visit in November 1984, and a second late summer visit in February 1985. The main objective of this survey was to obtain base line data for the reptile and amphibian species occurring in the Willandra Lakes World Heritage region. The approach to obtaining such data was twofold: firstly to determine the species diversity in the region by whatever methods were necessary i.e. specialized techniques or collecting sites for specific expected species, and secondly to survey the major habitats in the region and record the species composition for each particular habitat and the overlap of species between different habitats. The Australian Herpetological Society also visited this area briefly in autumn (April) 1988, and the records obtained are used here.

A total of 39 species of reptiles were collected or reliably identified from the Willandra Lakes region.

## MATERIALS AND METHODS

In surveying the region a number of collecting techniques were employed. Collecting of snakes and larger lizards was generally opportunistic as most were usually encountered when travelling between collecting sites. Data were mainly gathered by active morning, afternoon and evening searching in favourable areas in conjunction with a pitfall fence line trapping programme at each such site. The pitfall fence line technique consisted of a series of small buckets (20 cm deep) placed in the ground 2 metres apart in the shape of a cross, the length of each arm of the cross being approximately 10 metres. Over the top of the buckets was placed a low drift fence (20 cm high) to intercept and guide into the buckets animals passing through the area. At three sites (8b during first visit in November, and 1 and 5 during second visit in February) a pitfall grid system of approximately 20 buckets each 5 metres apart was used to provide a comparison of effectiveness between the two pit-trapping techniques. Results of the pitfall grid system were poor by comparison to the fence line technique.

Samples of the reptiles collected were lodged in the Australian Museum for reference and comparative morphological studies. A few specimens were also collected by Chris Tiedemann (Australian National University) during a concurrent survey of the mammals of the region. The localities for these species are included in the annotated list of species and are marked with an asterisk. Localities visited by the Australian Herpetological Society in April 1988 are indicated by a double asterisk.

Nomenclature generally follows Cogger (1986) except for the naming of the southern population of *Delma nasuta* as *Delma butleri* by Storr (1987).

Site co-ordinates and names were derived from the 'Pooncarie' 1: 250000 topographic map Sheet SI54-8 Edition 1 of the National Topographic Map Series.

## Major sites surveyed (Figure 1, 2).

1. 2.4km W of SE corner of Mungo National Park 33°48'S x 143°11'E (Figure 2a).
   Mallee woodland with *Triodia* understory on consolidated parallel red sand dunes.

2. 2.7km N of SE corner of Mungo National Park 33°47'S x 143°13'E (Figure 2b).
   Interdune area of mallee woodland with speargrass understory on red sand/soil.

3. 0.1km W of Joulni gate on southern boundary fence of Mungo National Park 33°48'S x 143°08'E (Figure 2c).
   Belah-rosewood woodland with scattered patches of bluebush, and a chenopod speargrass groundcover on red compact soil.

4. 0.8km E of Red Top Dam, Mungo National Park 33°47'S x 143°07'E (Figure 2d).
   Consolidated white clay lunette on eastern edge of Lake Mungo with patches of blue bush generally widespread, also some chenopod-speargrass ground cover, and occasional rosewood trees.

5. 2km E of Mungo homestead on Walls of China road, Mungo National Park 33°44'S x 143°02'E (Figure 2e).
   Lake floor of Lake Mungo with moderately dense blue bush shrubland and chenopod-speargrass ground cover on white clay soil.

6. Northern end of Mungo homestead airstrip, Mungo National Park 33°43'S x 143°02'E (Figure 2f).
   Cliffed red sand dune on western side of Lake Mungo with *Callitris* woodland and chenopod-speargrass ground cover, also occasional belah trees.

7. 3.3km S of Poo Poo Tank, Top Hut lease 33°43'S x 142°57'E (Figure 2g).
   Mallee woodland with sparse and scattered chenopod-speargrass ground cover on red sand-soil.

8a. 6.4km S of Top Hut homestead on Old Arumpo road 33°43'S x 142°55E (Figure 2h).
   Mallee woodland featuring *Triodia* understory on consolidated irregular red sand dune complex.

8b. 5.9km S of Top Hut homestead on Old Arumpo road.
   33°43'S x 142°56'E (Figure 2i).
   Blowout on edge of irregular red sand dune complex featuring large mature *Triodia* clumps only.

9. Approximately 3km due W of Gol Gol homestead 33°29'Ss x 143°18'E (Figure 2j).
   Consolidated white clay lunette on eastern edge of Lake Garnpung with scattered bluebush scrub. Area noticeably eroded and depth of soft white clay shallow (minimum approximately 10cm).

10. 5.8km E of Garnpung homestead on Gol Gol road. 33°30'S x 143°12'E (Figure 2k).
    Lake floor of Lake Garnpung with irregular scattered bluebush patches and dense chenopod ground cover on heavy, compact, grey soil.

11. Western edge of Lake Garnpung in vicinity of Scrubby Bore 33°27'S x 143°02'E (Figure 2l).
    Cliffed red sand dune on western side of Lake Garnpung at edge of massive red sand dune complex which extends further west, *Callitris* woodland with scattered chenopods, and occasional *Triodia* clump.

## ANNOTATED LIST OF SPECIES

### Family Agamidae

Amphibolurus nobbi coggeri

*A. nobbi coggeri* occurs in mallee woodland on consolidated irregular or parallel red dunes, usually where a *Triodia* understory is present. In November one gravid female was found digging what was presumed to be a nesting burrow.

Recorded from sites: 1; 8a; 8km NE of Roys Tank, Top Hut*; 7km NNE of Roys Tank, Top Hut*

Ctenophorus fordi

*C. fordi* occurs in mallee woodland with *Triodia* understory on consolidated irregular, and parallel red sand dune systems.

Recorded from sites: 1; 8a & b; 8km N of Roys Tank, Top Hut*; 9km E of Mandelman**.

*Ctenophorus pictus*

*C. pictus* occurs in mallee woodland on both the consolidated dunes and interdune habitats, the white clay lunettes, and open grass-shrubland in the vicinity of belah-rosewood woodland. It was not recorded from the lake floor or cliffed red sand dunes. Mature males with both red heads and yellow heads were observed basking.

Recorded from: vicinity of site 1; vicinity of site 3; Mungo lunettes *; Zanci lunettes*; 9km E of Mandelman**; 19km NNW of Bidura**.

*Pogona vitticeps*

*P. vitticeps* occurs in most habitats in the Willandra Lakes region.

During the November survey many individuals, mostly adult males, of this species were observed. Adult females at this time were infrequently encountered and usually gravid. One such individual was observed digging what is presumed to have been a nesting burrow.

Recorded from vicinity of most sites in the survey area.

### Family Gekkonidae

***Diplodactylus elderi***

*D. elderi* is restricted to large *Triodia* clumps occurring on consolidated irregular red dune systems, often in the vicinity of large blow outs where these clumps are the only immediate vegetative feature.

Specimens collected in the Willandra Lakes region represent an easterly range extension for this species in N.S.W., beyond that recorded by Shea and Wells (1985).

Recorded from sites: 8b; 2km W of Roys Tank, Top Hut*; 1km S of Double Tanks, Top Hut*; 9km E of Mandelman**.

***Diplodactylus intermedius***

*D. intermedius* was recorded from a single specimen pitfall trapped in belah-rosewood woodland approaching the eastern edge of Lake Mungo.

Recorded from vicinity of site 2*.

***Diplodactylus vittatus***

*D. vittatus* was recorded from 3 individuals, 2 from pitfall trap captures, in belah-rosewood woodland and mallee woodland (site 3 and 5km NE of Top Hut homestead*); and one active on the road at night in mallee woodland 25km NNW of Bidura**.

***Gehyra variegata***

*G. variegata* occurs in belah-rosewood woodland, *Callitris* woodland and mallee woodland. It is an arboreal species sheltering beneath exfoliating bark and in cracks in live or dead trees.

Recorded from sites: 2; 3; 7; Mungo Homestead; 2km NW of Top Hut homestead*.

***Heteronotia binoei***

*H. binoei* was most common in belah-rosewood woodland and *Callitris* woodland. A single individual was also pitfall trapped on the Lake Mungo lake floor. *H. binoei* occurs at artificial sites (e.g. man made debris piles) in habitats not normally occupied (i.e. blue bush shrubland in the vicinity of old Arumpo homestead).

Recorded from sites: 3, 5, 6; Old Arumpo homestead; Top Hut homestead; 2km NW of Top Hut homestead*.

***Lucasium damaeum***

*L. damaeum* occurs in mallee woodland on consolidated irregular and parallel red sand dunes, bluebush shrubland on white clay lunettes, and *Callitris*-rosewood woodland on cliffed red sand dunes. All these habitats feature open spaces of exposed soil or sand, and generally lack thick low ground cover.

Recorded from sites: 1; 4; 6; 7; 8a & b; 1km W Top Hut homestead; 3km W Roys Tank, Top Hut*.

***Rhynchoedura ornata***

*R. ornata* occurs in belah-rosewood woodland and adjacent open grassland, and mallee woodland.

Recorded from sites: 3; 2km NW Top Hut homestead*; 7km NNE Top Hut homestead*; 19km NNW of Bidura**.

***Underwoodisaurus milii***

*U. milii* occurs in mallee woodland on consolidated irregular and parallel dunes, and belah-rosewood woodland. One was dug from a complex multi-entranced burrow system, possibly an abandoned *E. inornata* burrow.

Recorded from sites: 1; 3; 1km W Top Hut homestead*; 9km E of Mandelman**.

## Family Pygopodidae

***Delma butleri***

*D. butleri* was recorded from mallee woodland with *Triodia* understory on consolidated irregular red sand dunes, and a *Triodia* covered blowout on red dunes. This species was previously identified as *D. nasuta* (Shea, 1987).

Recorded from sites: 8a &b; 4km S of Double Tanks, Top Hut*; 9km E of Mandelman**.

***Lialis burtonis***

A single individual was pitfall trapped in mallee woodland with a chenopod understory, adjacent to mallee woodland with *Triodia* understory.

Recorded from 7km NNE Top Hut homestead*.

## Family Scincidae

**Cryptoblepharus carnabyi**

A widespread arboreal species occurring in most woodland habitats. It was collected in mallee woodland on consolidated irregular and parallel red sand dunes, mallee woodland on the interdune between parallel dunes, belah-rosewood woodland, isolated rosewood tree patches on white clay lunettes and *Callitris* woodland on cliffed red sand dunes. This species also occupied man made structures i.e. water tanks, shed walls, fence posts.

Recorded from sites: 1; 2; 3; 8; 2km NW Top Hut homestead*; Top Hut.

**Ctenotus atlas**

*C. atlas* occurs only in mallee woodland with *Triodia* understory on consolidated parallel red sand dunes.

Recorded from sites: 1; 2km W of Roys Tank, Top Hut*; 9km E of Mandelman**.

***Ctenotus brachyonyx***

*C. brachyonyx* occurs only in mallee woodland with *Triodia* understory on consolidated irregular and parallel red sand dunes. Although moderately commonly collected from pitfall traps this species was rarely observed active.

Recorded from sites: 1; 8a & b; 9km E of Mandelman**.

***Ctenotus schomburgkii***

A single specimen was pitfall trapped in mallee woodland with *Triodia* understory on a consolidated parallel red sand dune.

Recorded from site 1.

***Ctenotus regius***

*C. regius* is the most widespread of the *Ctenotus* species occurring in the Willandra Lakes region. On the transect of Lake Mungo N.P. *C. regius* was recorded from mallee woodland on consolidated irregular and parallel red sand dunes, mallee woodland on interdune between parallel dunes, bluebush shrubland on white clay lunettes, and *Callitris* woodland on cliffed red dunes of Mungo Lake. Further to the north at Lake Garnpung *C. uber* occupies bluebush shrubland on eastern white clay lunettes, while *C. regius* was only recorded from *Callitris* woodland of red sand dunes on the west side.

Recorded from sites: 1; 2; 4; 6; 8a & b; 11; Zanci homestead*; 3km W of Roys Tank, Top Hut*; 7km NNE Top Hut homestead*; Old Arumpo homestead; 9km E of Mandelman**.

***Ctenotus uber***

*C. uber* occurs only on white clay habitats of the lake floor and lunettes on the east edge of the lakes. At Lake Mungo *C. uber* was collected in bluebush shrubland on the lake floor (common) and white clay lunettes (uncommon). At Lake Garnpung it was not recorded from bluebush shrubland on the lake floor, and was the only *Ctenotus* collected on the white clay lunettes.

Recorded from sites: 4; 5; 9.

***Ctenotus strauchii varius***

A single specimen was pitfall trapped in a patch of bluebush — chenopod shrubland on Garnpung lake bed.

This species was erroneously identified as *C. brooksi iridis* by Sadlier (1987). Rather this specimen represents a range extension for *C. strauchii varius* of over 475km to that given by Storr (1981).

Recorded from site: 10.

***Egernia inornata***

*E. inornata* occurs only in mallee woodland with *Triodia* understory on consolidated irregular and parallel red sand dunes. This species constructs elaborate burrow complexes with the main entrances usually focusing on *Triodia* clumps. Individuals were dug by day from these burrows or captured overnight in pitfall buckets. Numerous small juveniles were dug from individual small burrows in April.

Recorded from sites: 1; 8a; Roys Tank, Top Hut*; 9km E of Mandelman**; 19km NNW of Bidura**.

***Egernia striolata***

A single specimen was pitfall trapped in belah-rosewood woodland approaching the eastern edge of Lake Mungo.

This species is common in *Callitris* woodland in central and west N.S.W., and is usually located beneath the exfoliating bark of dead treas. Similar habitat was examined at Mungo N.P. but no further specimens were located.

Recorded from: vicinity of Everbar Tank, Mungo N.P.*.

***Eremiascincus richardsoni***

*E. richardsoni* occurs on the white clay lunettes on the east side of Lake Mungo and Lake Garnpung, and on the lake floor of Lake Mungo. All individuals were pitfall trapped overnight. Further to the west of the study site an individual was dug from loose sand on the floor of a rabbit burrow.

Recorded from sites: 4; 5; 9; approximately 45km W of Top Hut station.

***Lerista muelleri***

A widespread species occurring in all major habitats examined in Mungo N.P. It was most common in bluebush shrubland on the Lake Mungo lake floor, *Callitris* woodland on the cliffed red dunes bordering the western edge of Lake Mungo, and in belah-rosewood woodland.

This species was not collected at the three sites examined at Lake Garnpung but was collected on white clay dunes in the vicinity of Garnpung homestead.

Recorded from sites: 1; 3; 5; 6; 7; 8a; Old Arumpo homestead; Garnpung homestead; Top Hut homestead.

***Lerista punctatovittata***

*L. punctatovittata* occurs in habitats featuring red sand substrate, particularly *Callitris* woodland on cliffed red dunes bordering the western edges of the lakes, mallee woodland with *Triodia* on consolidated irregular red sand dune systems, and mallee woodland with chenopod understory on red soil. This species was not recorded from the white clay lunettes or floor of the lakes.

Recorded from sites: 1; 2; 3; 6; 7; 8a; 11; Old Arumpo homestead; Top Hut homestead.

***Menetia greyi***

*M. greyi* was recorded from single individuals in each of the following habitats: mallee woodland with *Triodia* understory on consolidated parallel red dune systems, and white clay lunettes (eastern edge of Garnpung Lake) and dunes (vicinity of Top Hut station).

Recorded from vicinity of site 1; 9; Top Hut homestead.

***Morethia adelaidensis***

*M. adelaidensis* was recorded only from bluebush shrubland on the lake floor of Lake Mungo and Lake Garnpung.

Recorded from sites: 5, 10.

***Morethia boulengeri***

*M. boulengeri* occurs in belah-rosewood woodland, and *Callitris* woodland on cliffed red dunes on the western sides of Lake Garnpung and Lake Mungo.

Recorded from sites: 3, 6; 11.

***Tiliqua occipitalis***

Recorded from a specimen display mount (obtained locally) at Mungo N.P. visitors centre and from local reports. Most landholders in the Mungo area know the 'western blue tongue' but all agree it is not commonly encountered.

***Tiliqua rugosa***

One of the most widespread lizard species in the region occurring on most sites examined in Mungo N.P. and recorded from numerous other localities in the Willandra Lakes region.

Recorded from vicinity of most sites in the survey area.

## Family Varanidae

***Varanus gouldii***

Widespread over the Willandra Lakes Region, and was recorded from a variety of habitats associated with both the lake bed and edges, and adjacent woodland habitats.

Recorded from: 0.2km N of Prungle on Arumpo road; 1.6km E Top Hut on Zanci road; 18.8km E Chibnalwood on Turlee road; 8.1km from Boronga on road to Mungo N.P.

## Family Typhlopidae

***Ramphotyphlops australis***

Recorded from a single gravid female pitfall trapped in November in mallee woodland with chenopod understory on red soil.

Recorded from site: 7.

***Ramphotyphlops bituberculata***

*R. bituberculata* occurs in *Callitris* woodland on cliffed red sand dunes (western side of Lake Mungo), and in mallee woodland with chenopod understory on red soil. All individuals were pitfall trapped during the hottest nights of the November survey.

Recorded from sites: 6, 7.

## Family Boidae

***Morelia spilota variegata***

Recorded from a single shed skin taken inside the Top Hut shearing shed. Most landholders in the area know the 'carpet snake' and report this animal is not commonly encountered, especially in more recent times (i.e. last 10 years).

Recorded from Top Hut homestead.

## Family Elapidae

***Demansia psammophis***

Recorded from two specimens, one collected from between mallee and woodland at Roys Tank (Top Hut)*, the other from blue bush scrub around Old Arumpo Homestead on the edge of Lake Arumpo.

***Pseudechis australis***

Recorded from a single specimen in the Prungle area (32km N of Prungle on Arumpo road) collected dead on the road where it passed through wheat fields.

***Pseudonaja nuchalis***

Recorded from a specimen from Turlee station, and a specimen from Milton Grove in the northeast of the Willandra Lakes region.

Two colour morphs are present: the individual from Turlee station is similar to what Mengden (1985) describes as the 'carinata' morph i.e. it has along the length of the body several series of (3) black and (3) white thin alternating bands with large sections of brown between. The individual from near Milton Grove is mid to dark brown overall with a slightly darker head (similar to the specimen depicted in Fig. 815 of Cogger 1983). This latter form of *P. nuchalis* could easily be confused with *Pseudonaja textilis* which looks superficially similar.

***Pseudonaja textilis***

Recorded sporadically throughout the Willandra Lakes region from a variety of woodland habitats other than mallee woodland: in the vicinity of Lake Garnpung from consolidated white dunes (southwest and east sides of the lake) with speargrass and bluebush scrub, the lake floor with scattered bluebush patches and thick chenopod cover, and the high interlake area between Lake Garnpung and Lake Leaghur which features thick bluebush scrub and chenopod cover.

Recorded from: 4km E of Garnpung homestead on Gol Gol road; 6.8 and 7.4km E of the Balmoral turn off on the Garnpung to Gol Gol road; 0.7km W of Gol Gol homestead on Garnpung road; 5.6km SW of Garnpung homestead; 5.2km S of Arumpo homestead on Mildura road; 15.8km S of Prungle homestead on Euston road.

***Unechis nigriceps***

Recorded from a single specimen pitfall trapped in *Callitris* woodland on cliffed red sand dunes on the western side of Lake Garnpung. This is the first record of this species for N.S.W.

Recorded from site: 11.

## DISCUSSION

A broad array of habitats adjacent to and including Lake Mungo were surveyed as a transect from the SE corner of Mungo National Park to the eastern half of Top Hut (sites 1-8 inclusive). This distribution of species by habitat is diagramatically presented in Figure 3.

At Lake Garnpung three habitats, the east and west rims, and lake bed were surveyed mainly to provide a comparison with similarly situated habitats on Lake Mungo but were

examined at different seasons (Lake Mungo spring; Lake Garnpung late summer). The lizard species component for each of the habitats surveyed on both Lakes Mungo and Garnpung is presented in Table 1.

TABLE 1: Comparison of comparable habitats on the east and west rims, and lake bed of Lakes Mungo and Garnpung.

| Species | Cliffed red sand dunes | | Lake floor | | White clay lunettes | |
|---|---|---|---|---|---|---|
| | Site 6 | Site 11 | Site 5 | Site 10 | Site 4 | Site 9 |
| *Pogona vitticeps* | + | + | + | + | + | + |
| *Heteronotia binoei* | - | - | + | - | - | - |
| *Lucasium damaeum* | + | - | - | - | + | - |
| *Ctenotus regius* | + | + | - | - | + | - |
| *Ctenotus uber* | - | - | + | - | + | + |
| *Ctenotus strauchii varius* | - | - | - | + | - | - |
| *Eremiascincus richardsoni* | - | - | + | - | + | + |
| *Lerista muelleri* | + | - | + | - | + | - |
| *Lerista punctatovittata* | + | + | - | - | - | - |
| *Menetia greyi* | - | - | - | - | - | + |
| *Morethia adelaidensis* | - | - | + | + | - | - |
| *Morethia boulengeri* | + | + | - | - | - | - |
| *Tiliqua rugosa* | + | - | + | + | + | + |

For each of the habitat pairs (see Table 1) the following broad observations and predictions can be made:

1. The cliffed red sand dune sites 1 and 6 on the western edge of Lakes Garnpung and Mungo respectively are similar in the agamid and small scincid lizard species present. The widely distributed gekkonid lizard species *H. binoei* and *L. damaeum*, and scincid lizard species *L. muelleri* and *T. rugosa* would also be expected to occur at site 11 and would make the lizard fauna of these two sites identical.

2. The lake floor sites 10 and 5 of Lakes Garnpung and Mungo respectively are similar in the agamid lizard species present. The gekkonid lizard *H. binoei* recorded from Lake Mungo may also be present on Lake Garnpung. *L. muelleri* which is recorded from Lake Mungo lake floor would also be expected to occur in similar habitat on Lake Garnpung. The small skink fauna of these two sites differ mainly in the distribution of species of the genus *Ctenotus: C. uber* is common on the lake floor of Lake Mungo but was not collected from the lake floor of Lake Garnpung while *C. strauchii varius*, recorded from a single specimen pit fall trapped in late summer on Lake Garnpung, was not recorded during the more extensive spring pitfalling session on Lake Mungo and is not expected to occur at site 5. To date the parapatric distribution of these latter two species is the only obvious distributional correlate with the soil and vegetation changes identified (Soil Conservation Service Land System Series Sheet SI-54-8) between these two nearly adjoining adjacent lakes.

3. The white clay lunette sites 4 and 9 on the eastern side of lakes Mungo and Garnpung are similar in the agamid and scincid lizard species present. The gekkonid lizard *Lucasium damaeum* recorded from site 4 may also occur on site 9. The main difference between sites 4 and 9 is the distribution of small scincid lizards *C. uber* and *C. regius*. At site 4 both species were present with *C. regius* the more common species while at site 9 only *C. uber* was recorded.

## COMMENTS

Of the species recorded only from mallee woodland with a *Triodia* understory *C. fordi*, *A. nobbi*, *L. dameum*, *D. butleri*, *C. atlas* and *E. inornata* also occur in similar habitat in central western N.S.W., whereas *D. elderi* and *C. brachyonyx* are not found in *Triodia* habitat east of the Willandra Lakes region (except for populations occurring in mulga and *Triodia mitchelli* habitat in central northern N.S.W.; see Sadlier 1987).

The scincid lizard *Morethia obscura* has been recorded from adjacent regions but not the Willandra Lakes region. The distribution of this species as given by Cogger (1988) includes southwestern N.S.W. and if present on the Willandra Lakes region would most likely occur in mallee associated woodland.

Shea (1985) also records the species *Cyclodomorphus branchialis* from southwestern N.S.W. west of the Darling River from *Triodia* dominated red sand ridges. It is possible *C. branchialis* may occur in similar habitat in the Willandra Lakes region.

The known distribution of *Echiopsis curta*, *Simoselaps australis* and *Vermicella annulata* as given by Cogger (1986) includes southwestern N.S.W., and all would be expected to occur in the Willandra Lakes region. *E. curta* and *S. australis* would most likely be expected to occur in mallee associated habitat. *E. curta* has been recorded just south of the regionof Bidura (Wilson and Knowles, 1988).

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Dr. Allen Greer reviewed this report; Tina Goh and Kelly Walker typed the various drafts; Kate Lowe and Debbie Kent assisted with figures 1 and 2.

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Figure 1a: Map of N.S.W. showing the location (shaded area) of Lakes Mungo and Garnpung as detailed in 1b.

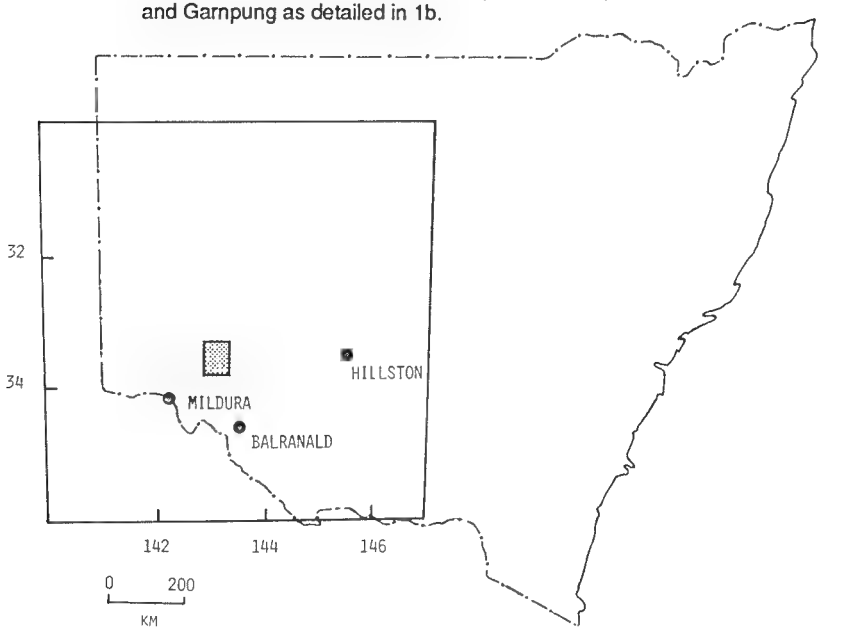



Figure 1b: Location of major sites surveyed.

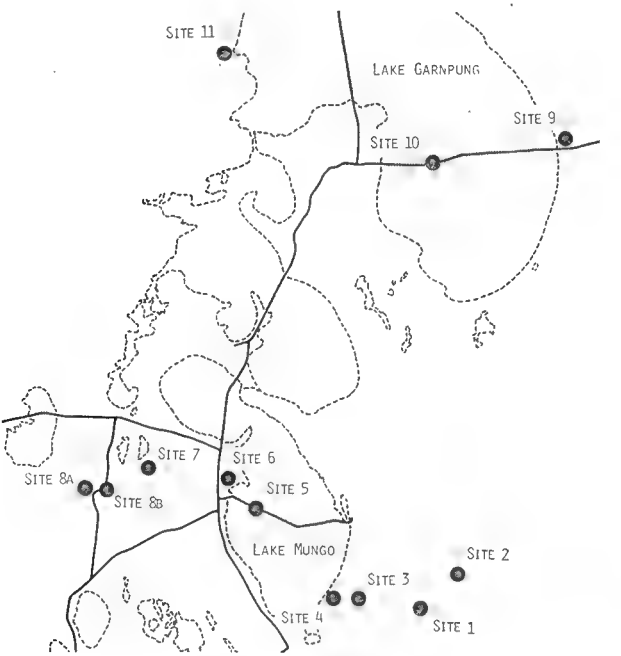


Figure 2: 2a Site 1; 2b Site 2; 2c Site 3; 2d Site 4; 2e Site 5, 2f Site 6; 2g Site 7; 2h Site 8a;

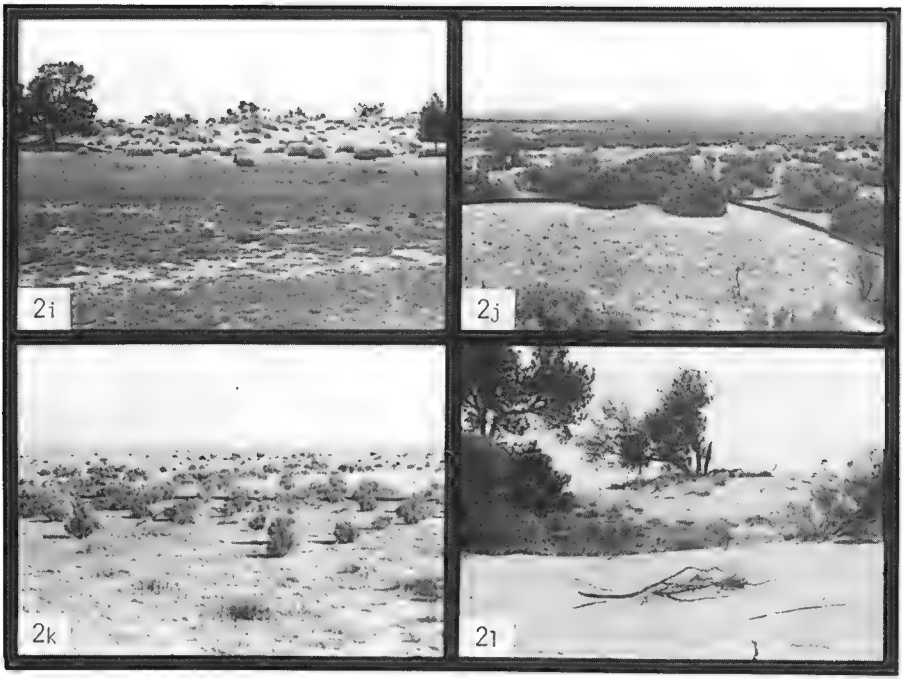



Figure 2: 2i Site 8b; 2j Site 9; 2k Site 10; 2l Site 11.

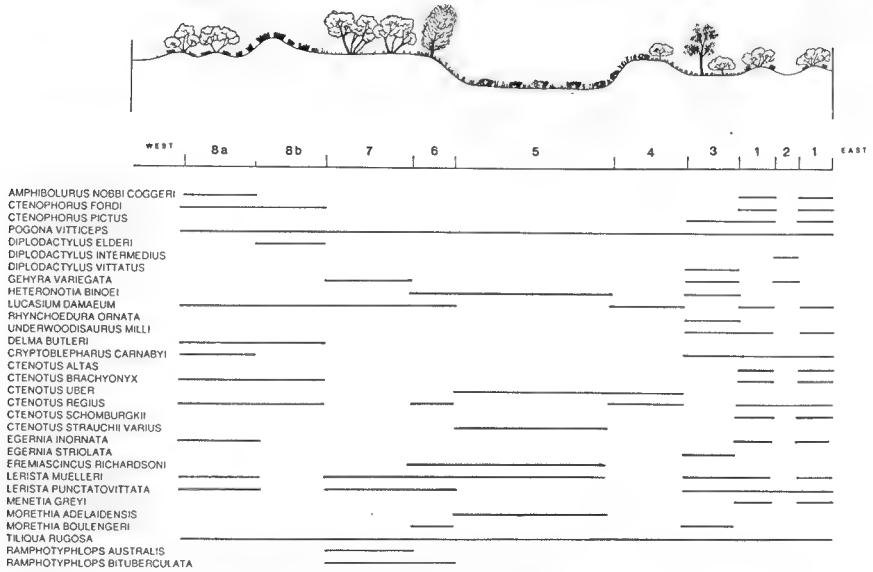



Figure 3: Diagrammatic representation of habitats in the Mungo National Park and the species distribution across these habitats.

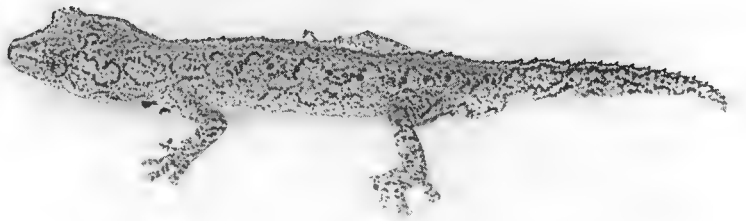


Figure 4. *Diplodactylus intermedius* Site 2, (photo R.A.S.)

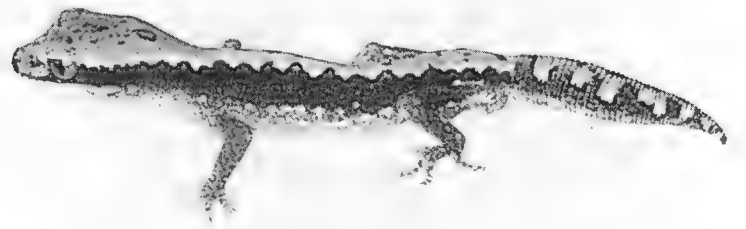


Figure 5. *Diplodactylus vittatus*, Site 3, (photo R.A.S.)

Figure 6. *Diplodactylus elderi*, Site 8b, (photo R.A.S.)

Figure 7. *Ctenotus brachyonyx*, Site 8a, (photo R.A.S.)

Figure 8. *Ctenophorus pictus*, Site 1, (photo G.M.S.)

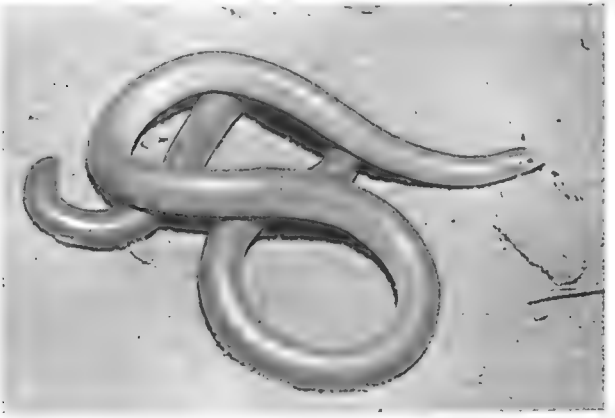
Figure 9. *Underwoodisaurus milii*, Site 1, (photo G.M.S.)

Figure 10. *Ctenotus uber*, Site 5, (photo G.M.S.)

Figure 11. *Eremiascincus richardsoni*, Site 5, (photo G.M.S.)

Figure 12. *Ramphotyphlops australis*, Site 7, (photo R.A.S.)

Figure 13. *Ramphotyphlops bituberculatus*, Site 6, (photo G.M.S.)



# POLYMORPHISM IN CAPTIVE BRED SIBLINGS OF THE SNAKE, *PSEUDONAJA NUCHALIS*

Brian Bush, 9 Birch Place, Stoneville W.A.

*Pseudonaja nuchalis* is widespread across most of mainland Australia being absent only from the extreme east, south-east and south-west. It includes a confusing variety of morphs which display little or no geographic isolation and considerable intergrading. Mengden (1985) pioneered the first study of the various colour/pattern morphs using biochemical techniques and clarified this complex situation. He classified the morphs and described chromosomal variations correlating with these, suggesting separate species may be involved. However, he was aware of the considerable ambiguity still surrounding the *nuchalis* problem and suggested the need for data on clutches to help clarify this. The problem is further compounded by the radical colour and pattern changes that occur in neonate and subadult *P. nuchalis* (Bush, 1989). These changes allow an individual snake to be placed in different colour morphs at different ages, and these morphs resemble some of Mengden's karyotypic morphs. This paper describes 2 cases of polymorphism in colour in siblings bred in captivity from adult *P. nuchalis* collected in the wheatbelt of Western Australia.

## PARENTS (1)

*Female* collected October 18, 1986 at Shackleton (31°50'S, 117°50'E). Colour – pale brown with indistinct nuchal chevron. Ventrals 222, subcaudals 55. *Male* collected October 27, 1986 near Wongan Hills (30°43'S, 116°43'E). Colour – yellowish-brown with distinct broad nuchal chevron and bright lemon-yellow throat extending onto sides of head. This snake has darkened considerably since capture. Ventrals 212, subcaudals 56.

## MATING/EGGLAYING/HATCHING

The adult male and female were first housed together in early November, 1987 and mating was observed at 12.14pm on December 1. Considerable bleeding from the female's cloaca was noticed and, after examining the bony recurved spines on the hemipenes in this species, was expected. These resemble medieval implements of torture rather than male sex organs. The pair were joined for almost 3 hours (to 2.55pm). Mating photographed (Fig. 1). No further mating was observed.

Egglaying commenced at 2.35pm on January 14, 1988 (Fig. 2) and was completed by 5.40pm the same day. 13 eggs measuring (mm) 36 x 19 – 44 x 22 (mean 40 x 20) and weighing (gm) 8.32 – 10.66 (mean 9.8) were deposited. Several of the eggs were heavily speckled with 1 – 2mm clear 'windows'. The period from recorded mating to egglaying was 45 days – although there may have been an earlier unobserved mating.

Eight eggs were placed on dampened vermiculite (verm. to water ratio 2-1 by weight) and incubated at 30°C. On April 4, 81 days after deposition, hatching commenced. Hatching in this sample completed by 6pm on April 6.

Five eggs were placed as above but incubated at room temperature (ca. mean 23°C). These commenced hatching on April 13, 90 days after deposition, and continued hatching until April 16.

## NEONATES

All emerged with the typical neonatal head markings in this species (see Bush, 1989 Fig. 2) but, after the completion of the second slough 33-36 days post hatching, could be placed to one of 3 distinct colour morphs: pale brown with nuchal chevron (5), yellow with 14-17 broad black bands and nuchal chevron (4) and reddish-brown with black head (2). Two of the banded morphs hatched from the eggs incubated at 30°C and 2 from the eggs incubated at the lower temperature. With the exception of a single banded morph all the hatchlings were males. Ventral and subcaudal counts for this clutch are 210 – 226 (mean 219),\ 56 – 60 (mean 59). Figure 3 shows banded and non-banded neonates.

A sample of banded and non-banded neonates are lodged in the Western Australian Museum (WAM R 100563-4).

This male and female were again mated towards the end of 1988 resulting in 20 eggs being deposited over the period November 7-13. Of these 12 failed, possibly as a result of lying in fecal matter for some time prior to being removed. These measured (mm) 36 x 17 – 41 x 21 (mean 38.5 x 19) and weighed (gm) 8.96 – 9.63 (mean 9.3). Eight eggs were successfully incubated at 30°C hatching on January 9 after 63 days. The neonates in this sample were banded (1) and non-banded (7).

## PARENTS (2)

*Female* collected October 26, 1987 at Ballidu (30°37'S, 116°46E). Colour – bright orange dorsally with strong 'herringbone' pattern caused by dark edges on some scales forming obscure bands; head and neck black. Ventrals 222, subcaudals 57. *Male* collected November 25, 1987 at Shackleton (31°56'S, 117°50'E). Colour – greyish-brown to pale olive with ill-defined 'herringbone' pattern; nose, sides of head and sides of neck black. Black absent from the supraoculars, frontal and parietals. Distinct nuchal chevron present followed by dark neck (see Fig. 4). Ventrals 211, subcaudals 55.

## MATING/EGGLAYING/HATCHING

The male was placed with the female immediately after capture and mating was observed at 5.30pm on November 27, 1987. The pair were joined for 3 hours 20 minutes (to 8.50). Egglaying commenced 52 days later on January 18. These eggs were of various sizes, 15 x 12 – 29 x 17, yellow in colour, and may be the result of reabsorption of the nutrients from the eggs by the female.

This pair were again mated towards the end of September, 1988 and, although mating was not observed, 12 fully developed eggs were laid on November 11. These measured (mm) 35 x 19 – 41 x 20 (mean 37.3 x 19.5) and weighed (gm) 8.27 – 9.42 (mean 9.15). All were successfully incubated at 30°C. Hatching commenced on January 11 after 61 days and was completed on January 16 after 66 days.

## NEONATES

All emerged with similar head markings to those in the previous example. Dorsally there was some variation in colour between individuals. The two extremes of this were reddish-brown and very pale brown or straw-coloured. All displayed the strong herringbone pattern typical in the sub-adults and young adults of this species (pers. obs.). None emerged with bands. After the postnatal slough, 11-14 days later, this clutch could be divided into two distinct colour morphs: orange with black head (3) and pale brown with nuchal chevron (9).

## DISCUSSION

The snakes from the 3 clutches demonstrate polymorphism, not only in neonatal colour between siblings but also relative to the age of the individual snake. The herringbone pattern occurs in all the young snakes, being represented by the very narrow bands in the banded morphs mentioned above. This pattern is uncommon in old snakes allowing the banded morph to be split in two, ie hatchlings through to young adults display the 'carinata' pattern while old adults lack the narrow bands between the broad bands and are simply banded morphs. The number of bands often decreases with age due to a fading of the anterior bands in some individuals. This has already occurred to some extent in the banded hatchlings retained alive from the first clutch described here. These are 17 months old now (sept. '89). The black head and neck frequently occurs in this species irrespective of back pattern or colour. As illustrated by Bush (1989), this can develop differently between individual snakes allowing the one snake to appear as separate colour morphs relative to age. Figure 4 illustrates an adult male *P. nuchalis* that could be described as an intergrade between 4 morphs as categorised by Mengden (1985) viz. a) brown with black head; b) southern; c) southern with black head and d) pale head-grey nape. This same snake, 2 years after being photographed, has changed considerably. The black on the head is as it was but the ground colour has changed to dark brown.

This study further highlights the ambiguity surrounding this highly variable species however, it does suggest one should err on the side of conservatism when considering the taxonomic dismemberment of *Pseudonaja nuchalis*.

In conclusion, these points need to be noted –

(1) Polymorphism in neonatal colour is now documented in the following morphs: "orange with black head"; "pale head, grey nape"; "southern"; "carinata" and "banded".

(2) The correlation between colour and karyotype is unlikely to be as close as suggested by Mengden (1985).

(3) Either species-barriers are breaking down (so hybrids are common) or there is a greater range of colour morphs *within* species, and greater colour overlap *between* species, than suggested by Mengden's initial results.

## ACKNOWLEDGEMENTS

Special thanks go to Gregory A. Mengden whose work on *P. nuchalis* stimulated my own interest in this problem. I also thank Rick Shine for his suggestions and assistance in preparing this MS. Gerry Swan's persistence as Editor of *Herpetofauna* suggests he is made of sterner stuff. Thanks.

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BUSH, B. 1989. Ontogenetic colour change in the Gwardar, *Pseudonaja nuchalis*. *West. Aust. Nat.* 18 (2):25-29.

MENGDEN, G.A. 1985. A chromosomal and electrophoretic analysis of the genus *Pseudonaja*. *In* The Biology of Australasian Frogs and Reptiles (Eds. G. Grigg, R. Shine & H. Ehmann), pp.193-208. Surrey Beatty & Sons, Sydney.

Figure 1. Mating of *Pseudonaja nuchalis* which resulted in 3 distinct colour morphs in offspring.
Note monotonal dorsum of mating pair.

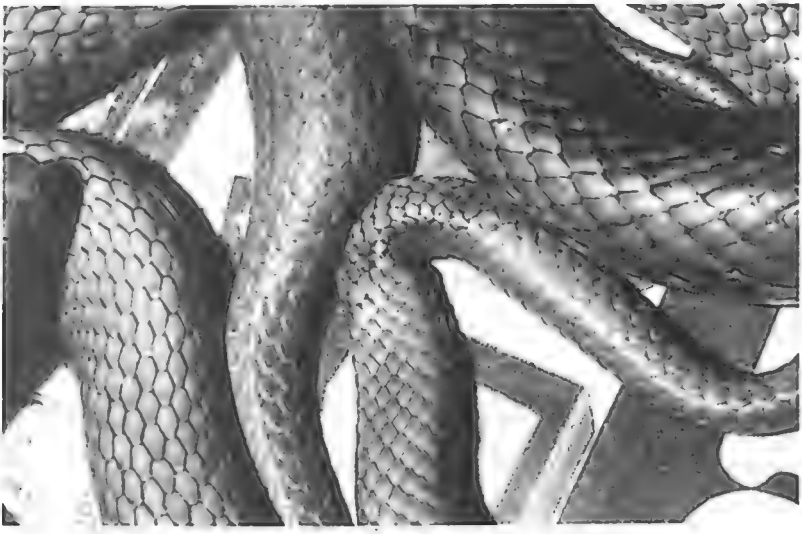


Figure 2. Egglaying in *Pseudonaja nuchalis* which commenced 45 days after mating depicted in Fig. 1.

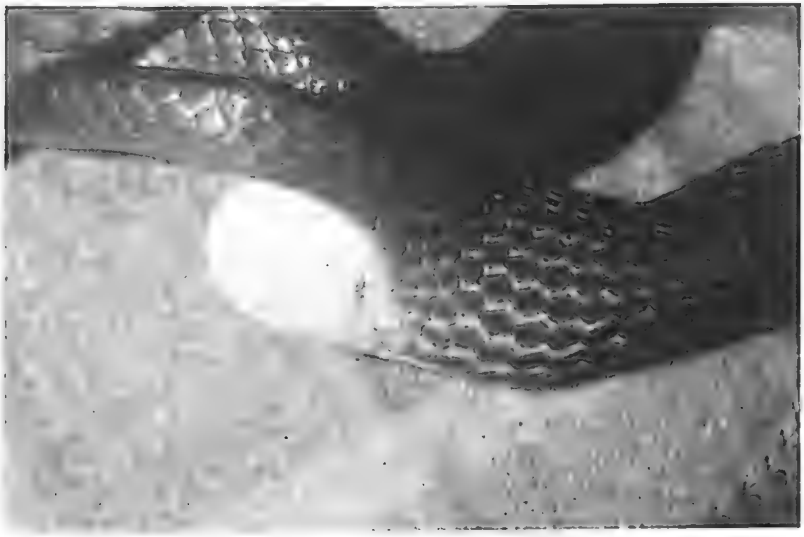
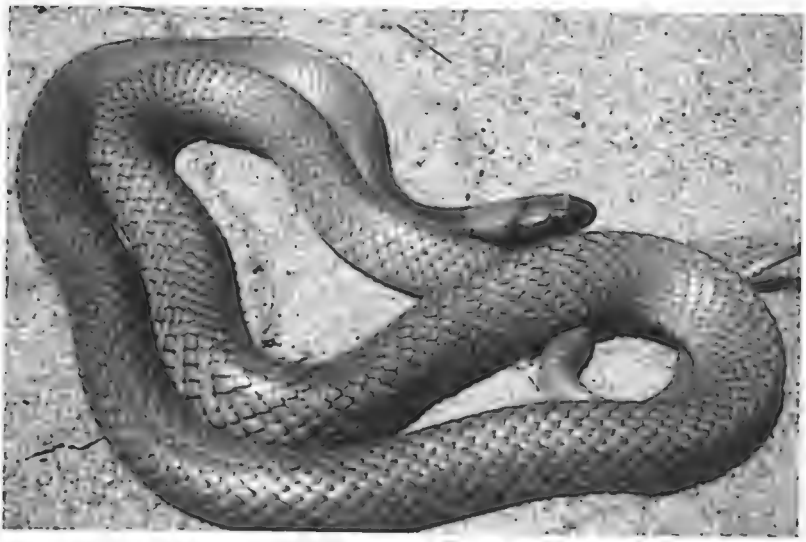


Figure 3. *Pseudonaja nuchalis* neonates immediately after emergence from egg. Note 2 distinct colour morphs. The third morph recorded is not detectable until after the second slough: the black on head will progressively fade highlighting the nuchal chevron.

Figure 4. *Pseudonaja nuchalis* adult male from Shackleton, Western Australia that could be described as an intergrade between 4 morphs as follows: a) brown with black head; b) southern; c) southern with black head and d) pale-head grey-nape.



# A SOUTHERLY EXTENSION TO THE RANGE OF THE AGAMID *AMPHIBOLURUS NOBBI NOBBI*

J.A. Fitzgerald c/- PO Box R307, Royal Exchange, Sydney 2000
R.C. Dencio c/- PO Box R307, Royal Exchange, Sydney 2000

A small agamid was closely observed by J A Fitzgerald on December 21, 1989 and recognised as *Amphibolurus nobbi*. On December 24 a specimen was collected from the same site and keyed out, confirming it to be *A n nobbi* (Witten 1972).

## LOCATION

The site is located in the ACT near the confluence of the Molonglo and Murrumbidgee Rivers 35°15'S x 148°59'E at an altitude of 475m and approximately 300 km outside the previously known range (Witten pers com) See Fig 1.

## DESCRIPTION

The eleven specimens found to date exhibit considerable polymorphism in respect to the dorsal markings ( see Fig 2.), which also appeared to be the case in other populations of *Amphibolurus nobbi*.

The snout-vent length (SVL) range recorded at this stage is from 27mm to 55mm. The size of adults also compares with other populations of *Amphibolurus nobbi nobbi* as Witten considers specimens over 50mm SVL as adults (Witten 1974).

Adult markings and colour consist of dark vertebral bands or blotches (often black) edged by two white or bright lemon paravertebral stripes. The dorso-lateral surfaces are usually a rich brick red with or without darker (if present usually black) ocellations.

Flanks are white or bright yellow. Some specimens show bright yellow on the ventral surface also. The lateral surfaces around the base of the tail vary from brick red to bright reddish pink. The buccal cavity has a distinctive bicoloured appearance, consisting of dark cobalt blue roof contrasting with a flesh pink tongue and lower mouth lining. Records of other populations of *Amphibolurus nobbi* have referred only to pink buccal cavities in the species eg.(Wilson & Knowles 1988). Cogger (pers com), however, has observed varying degrees of blue occurring in the buccal cavities of some individuals.

Animals found during Autumn were mainly hatchlings with SVL range of 27 to 35 mm which is analogous to hatchling sizes of *Amphibolurus nobbi nobbi* found elsewhere (Witten 1974). Hatchlings were identified by the fresh condition of the yolk sack scar. Neonates observed (except for the smallest specimen) displayed the same vivid markings and colours as adults at this time of year.

## HABITAT

The small agamid inhabits a river edge escarpment, consisting of deeply weathered, well jointed acid porphery rock, decomposing to a skeletal soil (Crowe pers. com.). The area has a northerly aspect as noted for other *Amphibolurus nobbi nobbi* breeding sites (Witten 1974). The locality is dominated by a stand of *Callitris endlicheri* interspersed with scattered *Eucalyptus spp.* Spread over the site is a mixture of small to medium shrubs including *Dodonea sp, Cassinea sp, Pomaderris sp* and *Leptospermum sp.* Two plants considered rare in the ACT, *Crowea exalata* and *Hibbertia calyana*, also occur on this site. The lower altitude at this northern end of the territory is likely to produce a marginally warmer temperature regime compared to other areas within the ACT (Ingwersen pers. com).

The dominant ground cover consists of a large tussock *Danthonia pallida* and a dense native creeper *Rhagodia nutans*, the latter being found primarily around the top of the escarpment. Both of these plants are utilised as refuge sites by this small agamid, *D pallida* being particularly favoured. The escarpment is well drained, holding no pockets of free water

even after heavy rain. Soil on much of the site appears to be mobile, readily washed and deposited between rock outcrops and on ledges, producing numerous ideal locations for oviposition. (see Fig. 3).

## DISCUSSION

The initial specimen collected from the ACT site is now lodged at the Australian National Wildlife Collection (R 5159) CSIRO Canberra.

Bylong NSW, approximately 300 km NNE of the ACT is the nearest, confirmed, locality of *Amphibolurus nobbi nobbi* at this juncture. The Bylong specimens (R 41155-7) are lodged at the Australian Museum (Witten pers. com.)

Of the two named subspecies, the ACT animals are consistent with *Amphibolurus nobbi nobbi*, indicating the eastern divide and associated ranges as the basis of distribution of this form, compard to a more westerly distribution for *A n coggeri* (Witten 1972) see Fig.1. Therefore there exists a strong possibility that *Amphibolurus nobbi nobbi* could be found to be distributed between Bylong and the ACT and further southward in association with the Dividing range.

## SYMPATRY

Some of the sympatric reptile species recorded to date are: Skinks- *Ctenotus taeniolatus*, *C robustus*, and *Egernia cunninghami*. Gecko - *Phyllodactylus marmoratus*. Elapid - *Unechis* dwyeri.

## ACKNOWLEDGEMENTS

We gratefully thank Dr A Thorne for the helpful suggestions on the manuscript, F Ingwersen for botanical and environmental information, W Crowe for geological information, Dr G Witten and Dr H Cogger for information on the Nobby Dragon. We also thank C Duby MLA for his assistance and the ACT Parks and Conservation Service for supplying permits for this study.

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G J Witten (1972) A new Species of *Amphibolurus* From Eastern Australia. *Herpetologica* 28 (3) 191-195.

G J Witten (1974) Population Movements of the Agamid Lizard *Amphibolurus nobbi. The Australian Zoologist* 18 (2) 129- 132.

Wilson S K & Knowles D G (1988) *Australian Reptiles. A Photographic reference to the Terrestrial reptiles of Australia.* Collins, Sydney.

Figure 1. Map of eastern Australia showing distribution of *Amphibolurus nobbi coggeri* and *Amphibolurus nobbi nobbi* including new locality ( adapted from Witten 1972).

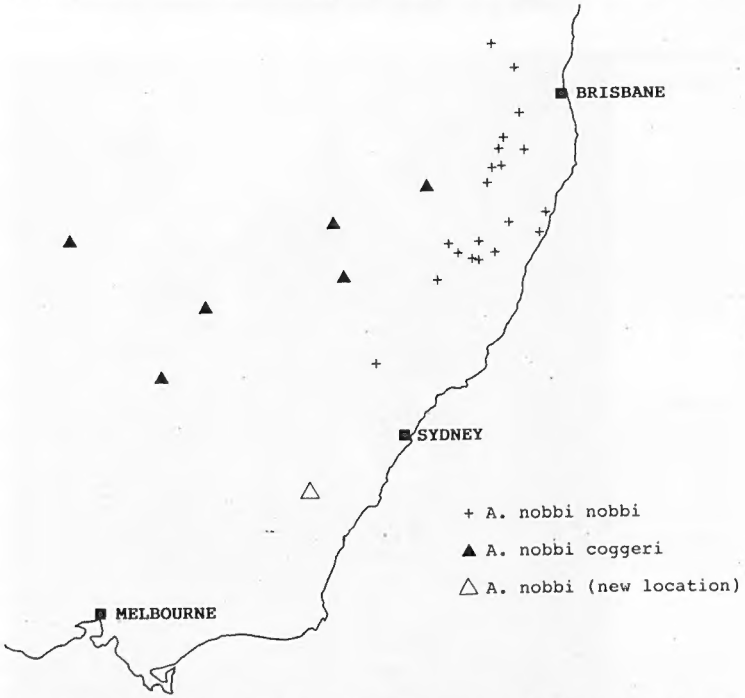


Figure 2. Three adult *Amphibolurus nobbi nobbi* specimens from the ACT showing polymorphic dorsal markings.

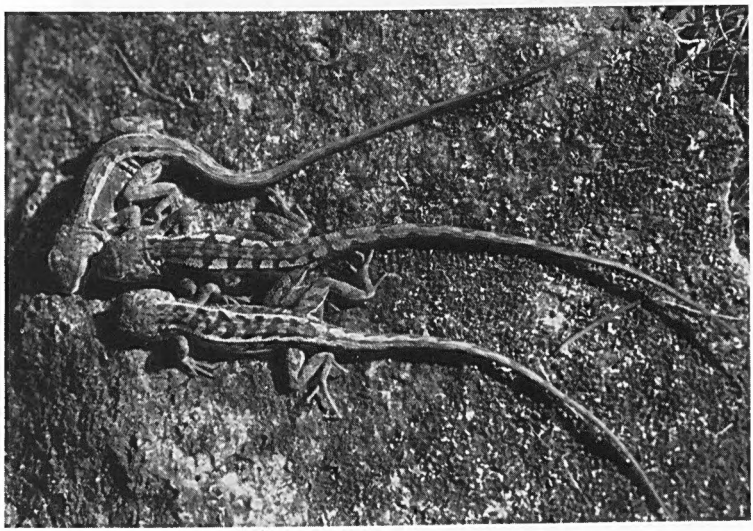

Figure 3. Topographical features of the ACT locality.

## CORRIGENDA

In the article "Comparison of feeding behaviours of the aquatic Australian hylid frogs *Litoria dahlii* (Boulenger 1896) and *Cyclorana platycephala* (Gunther 1873) and the terrestrial hylid frog *Cyclorana novaehollandiae* (Steindachner 1867)" in volume 19 (1) of Herpetofauna, G.Shea was accidentally omitted from the acknowledgements. Not only did he help in the preparation of the paper, he also took the phototgraphs used in it. Sincere apologies – M. Robinson.

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